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The Southwestern Desert Tortoise, *Gopherus agassizii*.

CHAPMAN GRANT.

Several enterprising youths in the vicinity of Hodge, San Bernardino County, California, have started commercializing the desert tortoise, *Gopherus agassizii*. May 8-11, 1935, was spent examining several small collections and Robert Heckly's two hundred specimens which were for sale to tourists. On another trip, October 2-9 inclusive, one hundred more specimens were examined. Most were in captivity, some were captured and some shells of dead specimens were studied. The favorable hours during which the tortoise ventures abroad were devoted to field work. Some observations that have not been seen in print are offered, together with additional data which may prove of interest.

ASYMMETRY.

Examination of plastrons showed that the suture between gulars is offset to the right from one to five millimeters, making the left gular wider. It does not protrude farther, but has a wider base and grows farther back on the plastron. Among 366 specimens, 331, or 90%, had the suture on the right, 23, or 6%, were median and 11 females and 1 male, or 3%, had a left suture. The 23 with central sutures were about evenly divided between the sexes. Plate XXIV of Ditmars' "The Reptile Book" (1907) illustrates the asymmetry. Additional evidence is shown in 15 plates by O. P. Hay in "The Fossil Turtles of North America." The left gular is larger in 7 plates and in no case is the right larger. Asymmetry of the gular scutes is in contrast to the median suture of the symmetrical underlying epiplastral bones. The gulars are either forked or worn chisel-shaped and recurved to a varying degree without apparent reference to age.

DIMORPHISM.

In the males secondary sexual dimorphism consists of larger size, longer gulars and tail, smaller pelvic clearance measured from seam of anals to edge of rear marginals, thickened anals and concave plastron, characters which make their appearance as the juveniles exceed 12 or 14 cm., with the difference in tail length showing first. The sexes have similar proportions except that the male exceeds by 2% in length of gulars and 5% in tail length, with a 2% smaller pelvic clearance. Among 366 specimens 19 females, 7 males and 4 young had major scute atavisms or abnormalities. One female was nearly circular, having narrow costals; another was elongated, having extra scutes, and a third was exceptionally high. The young are light, but color apparently has no sexual significance. Two partial albinos were seen with carapace, legs and toenails olive gray. The legs of

one large male were orange and black instead of the usual gray and black. Varying recurvature of the marginals over the hind legs and the amount of curving-under of the pygal as well as the considerable variation in number and arrangement of the inguinals are without apparent sexual significance. The color of the iris is brassy or brown or these two colors mottled, with about 80% brassy, 10% mottled and 10% brown without correlation to sex or age.

DIMENSIONS.

Table of dimensions in cm.

| | 30 adult females | Largest female | 30 adult males | Largest male |
|----------------------|------------------|----------------|----------------|--------------|
| Carapace length.... | 24.27 | 28.6 | 28.3 | 33.7 |
| Carapace depth.... | 10.4 | 11.5 | 12. | 14.6 |
| Greatest width.... | 19.8 | 22.9 | 23.17 | 26.7 |
| Plastral concavity.. | | | 1.47 | 1.8 |
| Gular length..... | 4.17 | 5.3 | 5.47 | 7.2 |
| Pelvic clearance.... | 3.6 | 4.3 | 3.9 | 4.5 |
| Tail length..... | 2.27 | 2.8 | 4.00 | 5.8 |
| Weight in gms.... | | 2,765. | | 5,809. |

DESCRIPTION.

Occasionally an old female is found with the caudal worn flat or even cut through, leaving a semicircular nick, as a result of being rubbed by the anal plates of the male. Growth rings are usually visible on full grown specimens, but disappear with age. Scutes become concave by thickening along their edges when age is attained. Occasionally spines about as long as the toenails, extending around the heel, give a starlike contour to the hind foot. The retracted thighs are protected by pointed tubercles, usually in the form of a circle around a large central spine.

HABITS.

One old male was seen with tail hanging down and slowly swinging from side to side with each elephantine step. A large male pushed himself along the ground carrying Robert Heckly and one persisted in crawling under the rung of my chair and tilting me. The little Heckly girls staged "roller skating" races, each standing on two tortoises.

Males utter grunting sounds while courting and recognize one another immediately, possibly by scent which may come from glands beneath the bulbs of the jaws. The long gulars are used by fighting males, which charge one another, their heads retracted. When one manages to ram his protruding gulars into the groin or anterior opening of the opponent's shell, he lifts and twists, often upsetting his antagonist. An overturned tortoise flaps one front leg violently, stopping it suddenly at the most forward position, the momentum jolting it slowly around so that any fixed object within reach may be utilized to right itself. Males may perish if they cannot turn over, since the hot sun is soon fatal. When asleep they sprawl legs and necks in the most grotesque positions, appearing dead. They become tame and inquisitive and seem to enjoy having their heads rubbed.

Fantastic stories of homing instincts may contain a grain of truth as the tortoises usually return to the same burrow nightly. Accounts of treks

or migrations and turtle towns are prevalent. I once saw what appeared to be a migration of *G. berlandieri* in southern Texas and have noted that tortoises are numerous only in restricted localities.

Robert Heckly furnished the following data: "In June, 1934, each of three females laid five eggs and one laid two in holes dug by the hind feet. It took an hour to dig the hole and fifteen minutes to lay the eggs. After depositing an egg, a foot was thrust into the hole, seemingly to roll the eggs from side to side or to pack them in. The hole was then filled and covered by the same process. Four from one female hatched in November, the fifth hatched the following March. The rest were infertile. By October the adults feed infrequently and by December have stopped entirely. They are placed in the cellar under canvas until March when they are brought out during the heat of the day to begin eating and mating, which is over by the last of April. They lay the latter part of June. They have been known to eat dried jackrabbit meat."

Tortoises are eaten during lean years, but no one seemed enthusiastic about the meat. I found the shells of three near the ashes of a small fire in the desert with evidence that the largest carapace had been used for a cooking vessel—an Indian custom. Escaped or liberated specimens are found with a hole drilled in the edge of the shell or a portion of the edge broken out.

Mr. Thomas Hallinan wrote an interesting article on *G. polyphemus* of Florida. Contrasts between the two species are that the present species makes no effort to escape by entering the burrow even if at the entrance, whereas the Florida species scrambles to escape. The burrow is much less steep, usually 12 degrees, starting against a small bank of wind-swept sand at the base of a bush, and humidity is disliked. In Florida the burrows are in damp ground and average fourteen feet long. In California the four-foot burrows are much straighter, the occupant frequently being visible. Never more than one tortoise and no associates, comensals or parasites were found in any burrow in California, whereas the Florida species has associates and parasites. Captive specimens at Thermal are subject to very active ticks which attack the sutures of the carapace instead of the skin and do not attach themselves.

WATER STORAGE.

Persons in the desert say that the tortoise stores water in sacs in each side of the body. The earliest reference noted is by E. T. Cox in the *American Naturalist* of 1881. He stated that while preparing a museum specimen he found on each side a large membranous sac filled with clear water. Dr. R. D. Harwood of San Diego State College kindly dissected two specimens for verification. He found the body cavity full of coelomic fluid and a large, simple, urinary bladder of delicate membrane lying ventrally across the plastron. The sides of the bladder, tucked up between the intestines and marginals on each side, have apparently been mistaken for independent sacs. Dr. Miller thinks that water is produced by metabolism.

YOUNG.

A captive tortoise laid six eggs at Victorville on June 9, 1935. On October 6, I purchased three of these eggs: one pipped, one nearly ready to hatch and one infertile. The remaining eggs were not for sale, but were sufficiently uncovered to see that they were fertile. The three eggs weighed and measured as follows: pipped egg 27.2 gm., 42 x 36.5 mm; fertile egg 30.2 gm., 42 x 37.5 x 35.7 mm; infertile egg with a large air bubble, 27.7 gm., 42 x 36 mm. The shell is hard and unyielding and when blown weighs

3.97 gm. Unfortunately the fertile egg was broken but the embryo was preserved. It was not ready to hatch, having blood vessels surrounding the white and the large yolk. Both this and the living specimen show great scute abnormality. No evidence was found that the eggs are buried singly as stated by Dr. Miller. The embryo lies partly curled and at right angles to the long axis of the egg. It has an egg tooth at the center of the snout with which it makes a ragged opening, parallel to the long axis. The egg tooth apparently is not shed, but flattens out after several months. The head is presented at 45 degrees, the eyes closed, but it opens its mouth threateningly if touched. The hatchling is wider than long, but unrolls and appears nearly normal in five days. A dozen captive babies were observed, all showing pugnacity, bucking forward with open jaws and hissing if touched on the carapace.

The baby hatched October 7, bearing a yolk sac and a small mass of clear, thick, jellylike substance under the plastron. The jelly dried up and the yolk was absorbed in two days. The baby measured in mm:

| | 1935 | | | 1936 | |
|--------------|--------|--------|---------|---------|---------|
| | Oct. 7 | Oct. 8 | Oct. 11 | June 18 | Aug. 15 |
| Length | 36 | 41 | 44 | 44.5 | 48 |
| Width | 39 | 37.5 | 36.5 | 36.5 | 42.5 |
| Weight | .. | .. | 19.7 | .. | .. |

It drank frequently, but ate almost nothing until May. Efforts to feed were clumsy at first, but by August it was eating tender vegetables, bananas, bread, dry grass with a generous proportion of dirt and slacked lime. It started to grow rapidly in July.

Mrs. Pajanew at Cinco had four that hatched on September 2. One had been sold, but on October 4 the remaining three weighed 23, 23.5 and 25.5 gm. Mr. G. W. Hilton near Coachella had one that hatched on September 15 and his son, John, of Thermal, reported numerous hatchings about August 15. Young specimens are soft, but when 10 cm. in length, or about five years old, seem able to resist carnivores, as several were seen with tooth marks on their shells.

RANGE.

The range was plotted on a map, using records from scientific books and articles, from the writer's observations and from verbal reports where three independent observers of apparent sincerity gave the same locality.

The tortoise does not occur in the Coachella-Thermal district where the temperature is probably higher than in their habitat, but Mr. Hilton's tortoises breed and reproduce well, showing that range restrictions are not due to temperature or low elevation.

The range was found to extend northward into the Panamint Valley and the Shoshone area in Inyo County. There are no records west of the Coachella Valley, so it does not approach San Diego County. It is reliably reported from the Beatty-Bunkerville line southward in Nevada and in Washington County, Utah, and the Phoenix-Florence-Tucson area of Arizona. There are a few Sonora records and one from Tiburon Island. This is a vast area, but great stretches are uninhabited.

In determining the range, tracks, burrows, droppings and dead shells are more convincing proof than a live animal encountered in an unexpected place, as there is always the likelihood that it may have escaped. At least 600 specimens were collected within two miles of Hodge in 1934-1935 ac-

ording to the census of the boys selling them. By driving to likely places, making a hurried reconnaissance and hunting only where tracks abounded the writer was able to collect ten specimens in about six hours—some in burrows and some feeding. They emerge in the forenoon and afternoon during spring and fall.

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